WEB-BASED SPATIAL DECISION SUPPORT SYSTEM TO EVALUATE BIO-ENERGY PROJECTS

Basic elements and User's guide

The bio-energy decision-making tool consists of a modelling section and a geographical information system both embedded in an interface accessible from the web, thus constituting a web based spatial decision support system (web-SDDS). The interactive mode of the tool that appears in the web is used as a means to demonstrate possible uses, at the same time, giving to the user the possibility to participate actively by suggesting parameters and investigating the results. The DSS contains technical, economic, and cartographic information to evaluate alternative bio-energy systems, to determine the optimal size, location and biomass crop cultivations subject to technical and resource constraints. At the optimal solution, it provides spatial and economic information on the bio-energy unit as well as on biomass raw material corresponding to the user-defined parameters. The number and location of land units cultivating biomass is determined by regional supply micro-economic models. As biomass resource is scattered in space, an important feature is the possibility of spatial visualisation of geographical information that enables the user to have a clear idea of input parameters and extensively explore results. Successive iterations assist the investigation of different variants of exogenous demand (the tool is demand driven, that is provided by the user based on site specific information at the regional level). Selected result values for different scenarios related to economic,
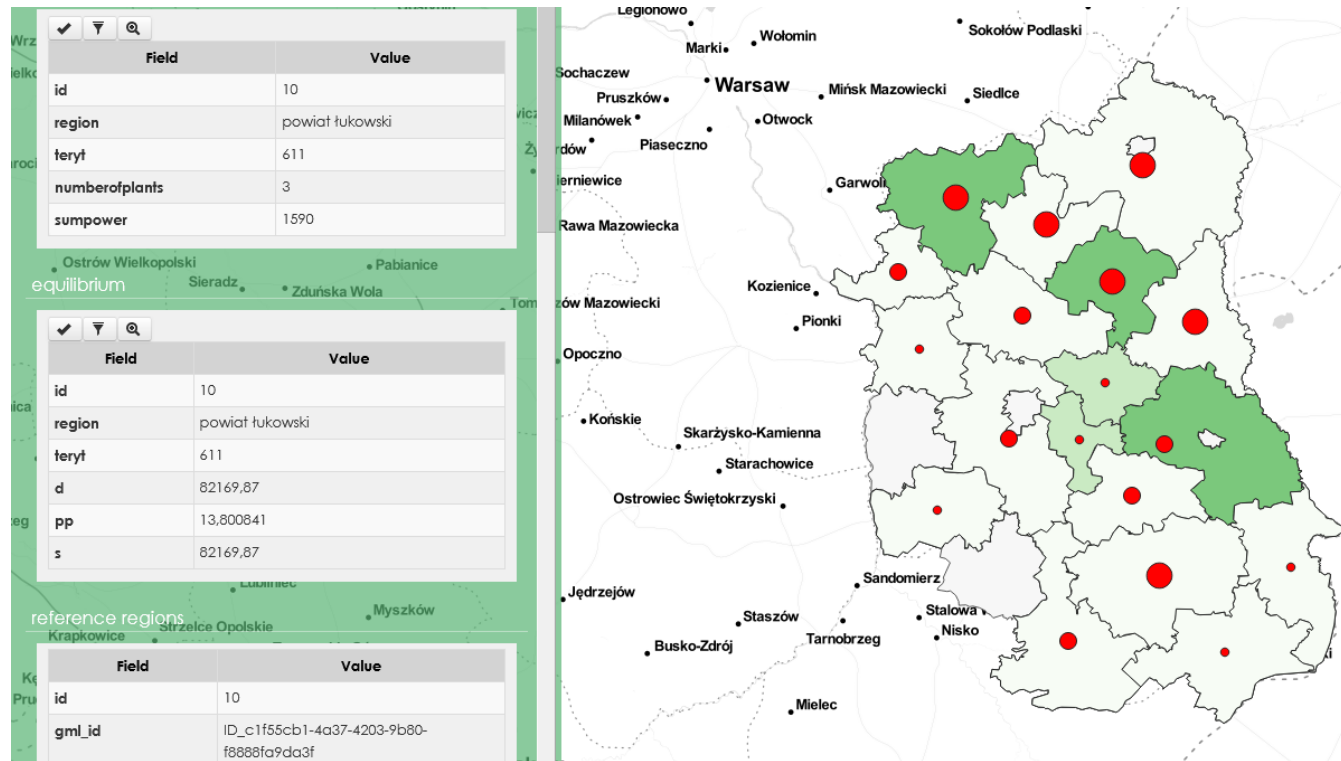
environmental and social impacts of the project, can be stored for further analysis. Based on scenario results, the user may undertake multi-criteria analysis to select among alternative crops, technologies and bio-energy plant location that correspond better to his/her values and objectives. SDSS architecture and web interface design for the case study of "Agricultural biogas development in Lubelski region" are presented in the next paragraphs.

Scenario for user will be defined based on the three components:

a) a vector of prices related to the power installed (brown cells). A default set of prices is inserted automatically when choosing from 2016-2018-2020 dropdown list, then the user can modify or complete for additional technologies (c7 etc.);

b) a biomass supply scenario (dropdown list choice of scenario1, scenario2, scenario3 that correspond to different context results of the agricultural model);

c) a set of parameters directly inserted by the user concerning: heat demand, heat price, investment subsidy, economic life time of amortization, rural development support to investment, discount rate.

b

c

		Add new plant	Launch GAMS	2016 ⌄	scenario2 ⌄	HEAT DEMAND 650	HEAT PRICE 40	INV SUBS % 50	LIFE TIME 20	RURAL DEVT % 10	DISCOUNT % 2	DISCFACTOR % 1635
CHECKED	TYPE OF PLANT	INSTALLED POWER	INVENT COST	ENERGY * EL	EL PRICE	ANNUAL REVENUE	MAIN-TENANCE COST	LUBRI-CANTS OIL	LOADER	CAPITAL RELATED COSTS	LABOUR	INSURANCE	ANNUAL COSTS	PROFIT	ROI-1	SORGHUUM	M/
	Unit	kW	th €	GWh	0.001*€/k	th €	th €	th €	th €	th €	th €	th €	th €	th €	%	t	
☐	c1	130	844.0	987	132	150.23	27.537	3.402	4.085	20.65	4.789	6.885	67.3	82.89	9.8%	2730	8
☑	c2	250	1386.7	1898.1	132	276.55	49.309	6.606	9.016	42.40	6.469	8.903	122.7	153.84	11.1%	5104	1
☐	c3	530	2652.8	3981.6	132	551.57	100.11	14.081	20.519	81.12	9.14	13.614	238.6	312.99	11.8%	10252	3
☑	c4	1000	4778.2	7312.7	132	991.27	185.382	26.63	39.829	146.11	12.24	21.52	431.7	559.56	11.7%	18608	7
☑	c5	2000	9300.4	14625.4	132	1956.55	366.813	53.33	80.914	284.39	16.837	38.342	840.6	1115.92	12.0%	35253	10
☐	c6	130	982.1	987	132	152.31	27.537	3.402	4.085	24.02	4.789	6.885	70.7	81.59	8.3%	3675	1

a

The scenario can be custom named by the user and somewhere there should be a text file with the above parameters with corresponding values selected representing the 'id' of the scenario. That will help the user to interpret the results.

Model Results

Field	Value
id	10
region	powiat łukowski
teryt	611
numberofplants	3
sumpower	1590

equilibrium

Field	Value
id	10
region	powiat łukowski
teryt	611
d	82169,87
pp	13,800841
s	82169,87

reference regions

Field	Value
id	10
gml_id	ID_c1f55cb1-4a37-4203-9b80-f8888fa9da3f

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Supply curves generated by the agricultural model are plotted against demand to determine the market equilibrium. The market clearing process takes place simultaneously determining equilibria in each decision making unit (*gmina* or *powiat* in this case, see map above). For the sake of illustration we pick in the left part one *powiat*. The pop-up window informs on the name and code of the *powiat* and also the number of biomass plants at the optimum along with the total installed electric power of biogas facilities. In the lower part information concerning equilibrium price of agricultural biomass (euro/ton) paid by the plant (13.8 euro/t of sorghum) with the total quantity supplied at the *powiat* level/annum (82169.87 t). Market clearing takes place in each DMU both for the units with installed plants and those who only provide biomass to the closest neighbouring plant.

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